U. S. ATOMIC ENERGY COMMISSION
HEADQUARTERS
DIVISION OF COMPLIANCE

October 10, 1964

CO REPORT NO. 47/64-2

Title: U. S. ARMY MATERIALS RESEARCH AGENCY
LICENSE NO. R-65
Date of Visit: September 28-29, 1964

By: J. R. Sears & R. T. Carlson, Reactor Inspectors

SUMMARY

The Army Materials Research Agency (AMRA) reactor was visited. No items of noncompliance were observed. Items noted during the visit included the following:

1. The present source-fuel-detector geometry results in limited multiplication being noted by the startup instrumentation during the approach to critical. The facility staff will re-evaluate this setup.

2. The replacement primary system heat exchanger tube bundle leaks. This is the second aluminum bundle that has leaked. Part 20 limits on liquid effluents have not been exceeded. A stainless steel unit is being considered.

3. A successful containment leak rate test was conducted in March, 1964.

4. The frequency of spurious scrams has been reduced.

5. The new boron-stainless steel safety rods have been installed.

6. Practice emergency drills are being conducted. The local hospital is reported to be well prepared to administer to radiation incident victims.

DETAILS

I. Scope of Visit

A visit was made to the AMRA reactor at Watertown Arsenal in Watertown, Massachusetts, on September 28-29, 1964, by Mr. John R. Sears, Reactor Inspector, Division of Compliance, Region I and

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Scope of Visit (continued)

Mr. Robert T. Carlson, Reactor Inspector, Division of Compliance, Headquarters. The visit was for a routine inspection and included a tour of the facility, a review of records and procedures, and discussions with members of the reactor staff.

Principal persons contacted during the visit included the following:

Mr. John J. O'Connor, Chief, Nuclear Reactor Facility
Mr. Charles E. Dady, Radiation Safety Officer

II. Results of Visit

A. Reactor Operations

1. Source-Fuel-Detector Geometry

Startup of this reactor is made using the beryllium reflector elements as a source. The original artificial source was removed some years back when it became apparent that the gamma-neutron background from the reflector was adequate. The present core configuration has the fuel essentially surrounded on three sides by reflector elements, with the fission chamber located centrally in the one row of these elements that is perpendicular to the remaining two rows.

The vertical axis of the chamber is in line with the axes of the elements in that row. Examination of the count rate recorder chart for the last reactor startup, and discussion with the on-duty reactor operator indicated that little neutron multiplication was detected between the start of rod withdrawal and the point defined as that at which the reactor was critical. Considerable multiplication was detected during the subsequent power ascension to full power (1 Mwt). During this period, the fission chamber was withdrawn incrementally each time the count rate recorder approached full scale.

When questioned about the limited multiplication noted during the approach to critical, Mr. O'Connor stated that he felt that it was adequate, but that he would re-evaluate the source-fuel-detector geometry currently in use.

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Results of Visit (continued)

2. Heat Exchanger

The new aluminum tube bundle in the primary system heat exchanger has started to leak. This exchanger is of all-aluminum construction with the primary system water passing on the tube side and the secondary water on the shell side. Mr. O'Connor stated that the leakage was evidenced by an increase in pool water conductivity during periods when both the primary and secondary systems are in operation. Under these conditions, the secondary side is at a higher pressure than the primary. When both systems are shut down, as is the case over weekends, the leakage is from the primary to the secondary due to the head provided by the reactor pool. The secondary side is supplied directly from the Arsenal well, without treatment, and discharges to the Charles River.

The tube bundle currently in service had been installed at some time prior to the last inspection (January 20, 1964) when tube failures in the original bundle became excessive. During the period when leakage was being experienced in the original bundle, daily samples were taken of the secondary water to determine the amount of activity being released. Records examined during the last inspection indicated that Part 20 limits on liquid effluents were not exceeded. Mr. O'Connor stated that a similar sampling program is in effect regarding the current leakage and that thus far the results have indicated it to be less severe than that previously experienced. The effluent secondary water is continuously monitored by a scintillation counter located on the exterior wall of the line downstream of the heat exchanger, thus providing indication of a major tube failure. The minimum sensitivity of the instrument is 10^{-5} uc/ml.

Mr. O'Connor said that current plans are to replace the existing exchanger with a stainless steel unit.

3. Reactor Operation Log

The inspectors reviewed the reactor operations logbook covering the period since the last inspection. The only item of note detected was an occasion when the gate was re-installed in the slot separating the annulus pool from the main pool. The installation was made during an off-shift and while the reactor was operating. When questioned

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Results of Visit (continued)

about the safety aspects of this operation, Mr. O'Connor stated that the work was done with his knowledge. Also, that the movement of the gate was done entirely from the annulus side of the pool thus avoiding the possibility of rupturing beam-port tubes should the gate be dropped.

4. Containment Leak Test

A successful containment leak rate test was conducted in March, 1964. The reference volume method was used with 2-50' lengths of copper tubing being employed as the reference volume. The tubing was pre-tested at 5 psig, and the test conducted at 2 psig with a resulting leak rate of 0.125% of the building volume in 24 hours. This result is comparable to the results obtained during tests conducted in March, 1963 when leak rates of 0.15% and 0.10% were measured (see CO Report No. 47/64-1).

5. New Control Rods

The new boron-stainless steel control rods have been installed. These rods were authorized as replacements for the original boron carbide rods by Amendment No. 4 to the operating license. No difficulties have been reported with the new rods thus far. Mr. O'Connor stated that the rods will be inspected every 50 Mwd as required by the license.

6. Pool Water

Mr. O'Connor stated that the primary pool water loss rate was about 3" per week or approximately 100 gallons per week. This he attributed to a combination of evaporation and sampling.

Pool makeup water is obtained from the domestic water system. It was stated that this was high in humic acid content and consequently it was necessary to pass it through an ion exchange column prior to addition to the pool. The domestic water is routed to a pressurizer from which it is pumped through the ion exchanger to the pool. The absence of a physical tie between the domestic water and the pool water system was confirmed by visual inspection by the inspectors.

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Results of Visit (continued)

7. Spurious Scrams

The frequency of spurious scrams has been reduced considerably during the past three six-month periods. Mr. O'Connor stated that the totals were 65, 33 and 9, respectively, with the latter being for the most recent period. One cause of the spurious scrams was thought to have been a damaged wire that was found in the circuit to one of the control rod magnets. The portion of wire involved was located in the control rod mechanism between the magnet and the drive unit. This was presumed to have been damaged during initial installation.

Work on the design of a transistorized control rod amplifier has been terminated as a result of the reduction in spurious scrams.

8. Reactor Use

The reactor is currently being operated approximately sixteen hours a day, Monday through Friday. It is used primarily for Army research. Mr. O'Connor stated that they were not actively soliciting outside work because of possible conflict with private industry.

B. Health Physics

1. Liquid and Gaseous Effluents

The inspectors reviewed the records for the gaseous and liquid activities released since January 1, 1964. The maximum concentration of gaseous activity was 2.9×10^{-6} uc/ml with the average for the period being approximately 2×10^{-6} uc/ml. These are within the limits of Part 20 considering the dilution factor authorized as the result of the installation of the 175' stack. Mr. Dady stated that this activity continues to be due principally to A-41.

The records of liquid activity released during the same period indicated that a total of about 200,000 gallons containing approximately 1 mc had been discharged.

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Results of Visit (continued)

2. Personnel Exposures

The inspectors reviewed the personnel exposure records. The maximum accumulated exposure by any one individual for the past year was 900 mrem. Approximately 500 mrem of this was received during a shutdown period in July 1964, when work was performed within the pool tank. A number of other persons received from 200 to 400 mrem during the same shutdown. No instances of exposures in excess of Part 20 limits were noted.

Film badges are still being processed by the Army Signal Corps in Lexington, Kentucky. Mr. Dady stated that he has some doubts about the reliability of this service in that results reported on badges that had been exposed to known amounts (test badges) were occasionally in disagreement by factors as high as $\pm$ 2. Mr. Dady is considering a visit to the badge processing facility in an attempt to resolve these differences.

3. Solid Radioactive Waste

Solid radioactive waste generated at the AMRA is composed primarily of contaminated paper and similar materials. The small amount they do accumulate is combined with that generated at the other facilities at Watertown Arsenal and disposed of by Marine Crossroads, a licensed waste disposal agency located in Boston.

C. Organization

1. Reactor Safeguards Committee

A review of the records of meetings of the Reactor Safeguards Committee indicated that the Committee continues to be active with meetings being held about once a month. The subjects noted to have been reviewed by the Committee since the last inspection are basically the same as last reported, i.e., new experiments, proposed irradiations, procedural changes and equipment modifications.

The current membership of the Committee is as follows:

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Results of Visit (continued)

Dr. Homer Priest - Director, Basic Research Lab, Watertown Arsenal
Dr. David Chipman - Basic Research Lab
Dr. John Antal - Basic Research Lab
Mr. John O'Connor - Chief, Nuclear Reactor Facility
Mr. Charles Dady - Reactor Health Physicist
Mr. Ken Tauer - Physical Chemist

Mr. O'Connor stated that the Committee performs audits of the facility operation on an annual basis. The merits of conducting more frequent audits, specifically, the examination of new experimental facilities following installation, was discussed with Mr. O'Connor. He indicated that this would be taken into consideration.

2. New Operator

One of the facility's most recent employees, Mr. Veinott, a licensed reactor operator, is a graduate of Wentworth Institute in Boston where he completed a two-year course in nuclear engineering. Mr. O'Connor spoke favorably of the training provided by this school as evidenced by the performance of Mr. Veinott.

D. Miscellaneous

1. Audits

Audits conducted by the Reactor Safeguards Committee are discussed in Section C above. Mr. O'Connor stated that the only other group that was currently performing audit-type functions was a team from the Army Inspector General Office. The last inspection by this group was conducted in April 1964. Mr. O'Connor said that the inspection team this year was composed of ten men and that they could do a better job with fewer people. He said that the items noted by the team during the last inspection were primarily minor industrial safety-type items. When asked about the qualifications of the team members, he said that it has improved through the years and that they now include at least one person associated with the reactor facility at Fort Belvoir.

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Results of Visit (continued)

2. Emergency Plan

The emergency plan for the reactor facility was discussed with Messrs. O'Connor and Dady. Practice drills are conducted periodically. Local organizations, such as the police, are included in the planning but do not participate in the drills. Mr. Dady stated that the local hospital designated to receive accident victims is well prepared to receive and administer to victims of radiation incidents.